Response to R1

Thank you for addressing the comments raised in my first review of the manuscript. I agree with the authors on the new structure starting more generally with the lead variability and trends after moving to the link between lead patterns and ocean bathymetry. It has a nice flow and feels more coherent now. It is also nice to see that you have tried to highlight the potential shortcomings in the abstract. Overall, with these new added changes, I think the manuscript is suitable for publication. I only have a few minor comments before the manuscript is finally accepted.

General comments

I agree that the data shows a compelling argument for the influence of ocean bathymetry on observed lead patterns. I also acknowledge that providing a detailed mechanistic understanding of the sea ice – ocean bathymetry interaction is perhaps too much to cover in this paper. Personally, I think it should be clearer that you're presenting this as a hypothesis (in the abstract) and that we don't understand the driving mechanisms in detail yet. I think this could help enhance the impact of the paper by inspiring future research (as you pointed out as a motivation in your response).

Good remark. We suggest the following change to the abstract…

The presented investigation provides evidence for an influence of ocean bathymetry and associated currents on the mechanic weakening of sea ice and the accompanied occurrence of sea-ice leads with their characteristic spatial patterns. ***While the driving mechanisms for this observation are not yet understood in detail, the presented results can contribute to opening new hypotheses on ocean-sea ice interactions.*** *The individual …*

When it comes to potential mechanisms, I recently came across this paper (https://onlinelibrary.wiley.com/doi/full/10.1029/2022JC019469), which shows how ocean currents and subsurface eddies can potentially imprint the sea ice cover mechanically. I think this would be a nice addition to the discussion (Section 4.2).

Thanks for pointing us to this reference! We've added it to the discussion (end of Section 4.2).

In your discussion about the trends, you mention the paper by Hoffmann et al (2022) showing a small increasing trend in Arctic leads. You mention that the discrepancy could be due to a large uncertainty and different lead climatology. That's all good. However, I would still like to see a very short discussion (1-2 lines) on some of the limitations of the ArcLeads product. Is it possible that uncertainties in LAF (e.g. from clouds) could be masking potential trends?

First, we want to make a correction to the regional monthly trends that we described in the revised version (Section 3.1). If a regional cloud-correction is applied, based on the relation between monthly cloud and lead frequencies, the mentioned trends with p-values <0.05 become even unsignificant (p-values increase when clouds are taken into account). Consequently, **a masking of trends through clouds can be ruled out**. We therefore need to change, however, the last sentence of the abstract and the last paragraph of section 3.1. accordingly. As other mentioned trends are not significant at the 5% level (some only at 10%) we think it's better not to point those out at all.

There is also small change in the Discussion section regarding the cloud correction (see below).

Specific comments

L5: *"... influence of ocean bathymetry and associated currents on the mechanic weakening of sea ice"*

I am not entirely convinced you actually show this. In order to strengthen that argument you would need to analyze the sea ice stresses from FESOM, and show a link between ice deformation rates and ocean currents. I would rather use "preconditioning" because we are not really sure how it works, right? Could be both mechanical or thermodynamic processes in play.

You are right that we don't know how it exactly works, but we do not think that replacing "influence" by "preconditioning" does make a difference here. We rather suggest changing "the influence" to "**an** influence" in order not to claim full insight into the mechanisms here.

L76: have --> has Done

L79: The Ocean data section I would still like to have 1-2 sentences explaining why FESOM is a good choice when it comes to representing ocean currents in the Arctic. You need to convince the reader that the model is appropriate for your specific study.

We added: **FESOM has previously been used also in other studies for the simulation of ocean currents in the Arctic (e.g., Wang et al., 2016; Wekerle et al., 2017)**

L102: I am still confused about the deformation derived from the C15 wind data. "Total deformation" makes me think of sea ice, not winds. As I understand it, you're calculating the total deformation (div+shear) of the wind (not the sea ice?). However, I don't think you need to mention the total deformation since it's just the sum of shear and div?

That's right, mentioning total deformation here is redundant. We changed to "shear"

L135: You should specify that the trend is for the entire winter season.

This is added now.

L149: *"is generally characterized by a variability that is less pronounced than in other sectors."*

A bit unclear what you mean by less pronounced variability. What about: “Generally shows less (interannual/monthly?) variability compared to the other sectors”
Phrasing is adjusted accordingly.

L156-159: This would fit better in the discussion. I would also consider moving the paragraph on monthly trends (from L160) to after you talk about absence of interannual trends on seasonal timescales (L135).
We do not understand this suggestion, unfortunately. The text on monthly trends is already at the end of the paragraph and the discussion picks up this information later on.

L167: Explain briefly why you compare lead patterns to model data, e.g. “to understand the role of the ocean...”
We added … “**to evaluate a potential role of the ocean in shaping the presented observations**”

L187: *“which means that the sea ice in this region is covered by leads in more than 40% of the time in the winter period from November to April.”*
I would use this phrasing already in the first section (L112) because it helps the reader understand what the LFQ means.
We rephrased the specified sentence in L112 to be more specific.

L243: Your comment to R2 that using daily atmospheric data doesn’t make a huge difference compared to monthly data should be mentioned explicitly in the text (Section 3.2.5).
We added: “**This also holds for when daily, instead of monthly wind data are considered”**.

L244-245: The first two lines belong in the previous section. Here it sounds like you are about to talk about the ocean impact on leads, instead of summarizing the results of the precious section.
I suggest starting this section by: “To understand the role of winds in driving the observed patterns in lead formation we look at ...”
We think this is a valuable suggestion. We moved the first sentence to the end of the last section and start this section with **“To understand the role of winds in driving the observed patterns in lead formation we look at wind components and derived mean quantities.**”

L313: *“However, we could not observe trends in wintertime lead fractions in the period between 2002 and 2021 (see Figure 2)”*
Please clarify that you’re talking about pan-Arctic here since you find trends on regional scales.
Here I would also like to see a sentence on the uncertainties in ArcLeads product and its effect on the reported trends (or absence thereof), e.g. due to clouds. See my general comment.
We added ***pan-Arctic*** here. We are referring to uncertainties and your general comment by also adding:
“***The trends in detected leads can be biased by overlying trends in cloud frequencies. This effect is, however, compensated for in our trend calculation.***”

L353: Add a reference to
Done.

L369: What do you mean by *“dynamic weakening through changing water masses”?* Please clarify
“... while positive trends in ...” Please clarify trends in what (sea ice?, ocean heat?)
We changed “*the already present*” (misleading, in fact) to “***a potential***”.
We changed the sentence to “***Consequently, lead fractions are likely to increase here when increased oceanic heat fluxes persist.”***

L380: This section reads more as a conclusion. In particular, the last part highlighting open questions. If I may, I would suggest moving the “open questions” to the Conclusion as “suggestions for future work” (e.g. for the modelling community) in order to foster and inspire more in-depth research.
Good suggestion. We moved the open questions to the Conclusions.

Response to R2

The authors have improved the manuscript based on the reviewer comments. It is my opinion that the manuscript should be published, subject to (very) minor revisions, as detailed below.

157 - slight rephrasing would help, I had to read the sentence a couple times to follow. What quantity did Wang et al. (2016) measure? I’d replace “did report no” with “reported no”.+
Done.

171 - I believe you mean “Laptev Sea”? Vilkitsky Strait connects the Kara and Laptev Seas.
No actually, we mean Barents Sea.

178 - The idea of the sentence works, but it needs to be rephrased to avoid being a run-on sentence. Perhaps “These are regions with complex bathymetry, and hence…” I think that the phrase “a lot of details” is too colloquial.
We guess that the problem was due a missing “and”, which is now added.

199 - Island should be capitalized
Done.

203 - no comma needed before F_SCV
Removed.

234 - 90th percentile is correct, as you had it originally, rather than 90% percentile
Changed.

277 - no comma needed between regions and “where a significant”
Removed.

278 - I’d rephrase as “In both the Beaufort Sea and in Fram Strait”
Done.

360 - Tides impact sea ice both through inducing a vertical gradient in the surface current and by enhancing the upward heat flux. You mention tide induced shear a few lines above, so perhaps all you need to do is change “tides” to “tide-driven mixing”.
Good suggestion. Changed.

414 - I think the final sentence can be improved. As in the sentence in line 178, I think the phrase “a lot of details” is too colloquial. I think that reworking the last two sentences can help emphasize that your paper has demonstrated that there is useful local information provided in the lead fraction dataset, and that future work can leverage this dataset for more detailed investigations of the local forcing
Done.